CLAIMS

Having thus described our invention in detail, what we claim as new and desire to secure by the Letters Patent is:

1. A method for delineating crystal defects in a Si/SiGe bilayer structure comprising the steps of:

first etching a structure including a Si layer located on a SiGe alloy layer with a defect etchant that is defect selective in Si to form at least one pit defect in the Si layer that is in contact with the SiGe alloy layer; and

second etching the structure containing the at least one pit defect with the same or different etchant as the first etching such that the second etching undercuts the SiGe layer beneath the at least one pit defect.

2. The method of Claim 1 wherein the Si layer is formed by epitaxy, and the SiGe alloy layer is formed by epitaxy.

3. The method of Claim 1 wherein the Si layer is a strained layer and the SiGe alloy layer is a relaxed layer.

4. The method of Claim 3 wherein the strained layer has a thickness of about 100 nm or less and the relaxed layer has a thickness of from about 10000 nm or less.

5. The method of Claim 1 wherein a thermal mixing process is employed in forming said SiGe alloy layer atop a buried insulator layer of a silicon-on-insulator substrate.

6. The method of Claim 1 wherein the SiGe alloy layer comprises up to 99.99 atomic percent Ge.

7. The method of Claim 1 wherein the SiGe alloy layer is formed atop a substrate.

8. The method of Claim 7 wherein the substrate is bulk Si or a silicon-on-insulator-based substrate.

9. The method of Claim 1 wherein the defect etchant comprises a mixture of HF and potassium dichromate, a mixture of HF, potassium dichromate and distilled water, a mixture of HF and chromium trioxide, or a mixture of HF, chromium trioxide and distilled water.

10. The method of Claim 1 wherein the defect etchant comprises 2 parts HF and 1 part of a 0.15M potassium dichromate solution and 6 parts deionized water.

11. The method of Claim 1 wherein the defect etchant etches dislocation and stacking fault defects at a much faster rate than non-defective Si.

12. The method of Claim 1 wherein the first etching is performed using a graded etching process.

13. The method of Claim 1 wherein the second etching employs the same etchant as the first etching.

14. The method of Claim 1 wherein the defect etchant and the etchant in the second etch are both comprised of 2 parts HF and 1 part of a potassium dichromate solution and 6 parts deionized water.

15. The method of Claim 1 wherein the second etching is performed using a different etchant as the defect etchant, said different etchant etches SiGe at a faster rate than Si.

16. The method of Claim 15 wherein the different etchant comprises HF/H_2O_2/acetic acid or Nitric/HF.

17. The method of Claim 15 wherein the different etchant comprises 1 part HF/2 parts H_2O_2/ and 3 parts acetic acid.

18. The method of Claim 1 further comprising a rinsing step between said first and second etching steps.

19. The method of Claim 1 further comprising scanning the first and second etched structure under a microscope to identify regions where the pit defect has been undercut and calculating the defect density based on total undercut pit defects divided by area.

20. A method of measuring the crystal defects in a Si/SiGe bilayer structure comprising:

first etching a structure including a Si layer located on a SiGe alloy layer with a defect etchant that is defect selective in Si to form at least one pit defect in the Si layer that is in contact with the SiGe alloy layer;

second etching the structure containing the at least one pit defect with the same or different etchant as the first etching such that the second etching undercuts the SiGe layer beneath the at least one pit defect; and

scanning the etched structure under a microscope to identify a region where the at least one pit defect is undercut and calculating the number of defects in terms of defect density.